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HANDBOOK
FOR
TEST SET MW 69/S
MARK II

MP MASTER
MA23490

HANDBOOK

FOR

TEST SET MW 69/S

MARK II

HANDBOOK FOR
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1. INTRODUCTION

The MW 69/S has been designed as a general purpose 'S Band' radar test set. It includes, in one cabinet :

(a) a high speed oscilloscope to monitor, with high accuracy, all the waveforms to be observed in a radar transmitter;

(b) a spectrum analyser to display the spectrum of the RF pulse of an 'S Band' radar. Included is a test point for CV2154, CV2155 or similar crystals.

A single switch selects either the oscilloscope or the spectrum analyser operation.

The Y-amplifier comprises a main D.C. differential amplifier, with a compensated input attenuator, and an A.C. pre-amplifier which may be switched in at the input. Measurement of input voltages is carried out by a calibrated shift voltage which is connected to one side of the differential amplifier. The input condition may be either high impedance A.C. or D.C. or terminated with 75 ohms (1 watt maximum load).

The Time Base consists of a 'Bootstrap' time base generator and incorporated circuits to prevent double triggering. Measurement of time is carried out by a calibrated shift voltage which is connected to the X-amplifier.

The Spectrum Analyser comprises a single superheterodyne narrow band receiver, whose centre frequency can be linearly swept over the side-bands of a RF pulse.

The sample of RF pulse to be analysed is connected via an R.A.E. connector. Provision is also made to inject a sample of the Local Oscillator to monitor the operation of the radar A.F.C. (MW 69/S Mark II/15 for Radar IF 30 Mc/s and MW 69/S Mark II/7 for Radar IF 13.5 Mc/s.) The Local Oscillator of the analyser consists of a CV 2116 klystron in an external resonant cavity.

The sweep voltage is applied on the reflector; its amplitude being controlled from the front panel. The power mode of the klystron may be observed on the oscilloscope.

'Bright-up' circuits are incorporated to enable the spectrum to be seen more distinctly.

The Mark II equipment, compared with the Mark I, has improved circuitry giving an all-round improvement in the specification and facilities to change the IF frequency and bandwidth of the Spectrum Analyser (see Section 5.1.4.). At present there are two IF frequencies available: 15 Mc/s and 6.75 Mc/s.

2. SPECIFICATION

2.1. Oscilloscope

Y-amplifier characteristics:

RANGE	FREQUENCY RESPONSE	APPROXIMATE SENSITIVITY
500V 250V 100V 50V	D.C. to 10 Mc/s (-3 dB)	60V/cm 30V/cm 12V/cm 6V/cm
25V	D.C. to 5 Mc/s (-3 dB)	3V/cm
10V	D.C. to 2 Mc/s (-3 dB)	1.3V/cm
5V	D.C. to 1 Mc/s (-3 dB)	0.6V/cm
Pre-amplifier	1 c/s to 1 Mc/s (-3 dB)	60mV/cm

Accuracy of voltage measurement ± 3%

Time-base characteristics:

TIME BASE RANGE	VELOCITY	TIME BASE RANGE	VELOCITY
1 µs	0.15µsec/cm	1 ms	0.15msec/cm
3 µs	0.45µsec/cm	3 ms	0.45msec/cm
10 µs	1.5 µsec/cm	30 ms	4.5msec/cm
30 µs	4.5 µsec/cm	100 ms	15 msec/cm
100 µs	15 µsec/cm		
300 µs	45 µsec/cm	300 ms	45 msec/cm

Accuracy of time base measurement ± 3%

A 5 Mc/s calibration waveform is available on the 1 microsecond range.

An external trigger is required (a positive going pulse greater than 4 volts amplitude and 1 microsecond wide); the input impedance is 68 ohms.

2.2. Spectrum Analyser

Frequency Band	:	2,700 - 3,050 Mc/s
Sweep Width	:	25 Mc/s (- 3dB)

2.2.1. MW69/S Mark II/15

Bandwidth	:	100 Kc/s (-3 dB)
Intermediate Frequency	:	15 Mc/s ± 10 Kc/s

Suitable for radars with the following characteristics:

p.r.f.	> 250 pps
Pulse length	2 - 0.3 microseconds.

2.2.2. MW69/S Mark II/7

Bandwidth	:	20 Kc/s (-3 dB)
Intermediate Frequency	:	6.75 Mc/s ± 10 Kc/s

Suitable for radars with the following characteristics:

p.r.f.	> 150 pps
Pulse length	10 - 0.3 microseconds

2.3. General

Power requirements	200 - 250 volts 50 c/s 320 V.A.
Weight	140 lbs.
Overall Dimensions	Width 22½" Depth 18" (plus 6" for CRT hood) Height 23".

3. OPERATING INSTRUCTIONS

3.1. Introduction

Before connecting the instrument to the supply, adjust the mains voltage selector at the rear of the instrument to the setting nearest to the supply voltage.

A positive going pulse of at least 4 volts amplitude and approximately 1 microsecond wide is required to trigger the time-base.

3.2. Controls (NOTE: All controls titles are printed in capital letters)

3.2.1. OPERATION SWITCH

This selects the mode of operation of the test set, either Oscilloscope or Spectrum Analyser. The latter has two positions KLYSTRON MODE or SPECTRUM. On KLYSTRON MODE the oscilloscope displays the power mode of the klystron and on SPECTRUM the RF spectrum of the input pulse.

3.2.2. INPUT SELECTOR

The external input to the Y-amplifier can be either high impedance (A.C. or D.C.), or terminated by 75 ohms. It is to be noted that when terminated by 75 ohms, the resistor is of 1 watt rating allowing a maximum of 8.5 volts D.C. or 24 volts peak to peak sinewave. When the Y-AMPLIFIER is set to PRE-AMP, the signal is coupled in A.C. only.

3.2.3. TIME-BASE RANGE

Time-base ranges of 1 microsecond to 300 milli-seconds are selected by this control. A 5 Mc/s time calibration waveform can be displayed on the 1 micro-second time base (See Y-AMPLIFIER 3.2.5.).

3.2.4. X-SHIFT TIME

Time measurement is made by the use of the dial on this control. Full scale reading of the dial is equivalent to the TIME-BASE RANGE in use.

3.2.5. Y-AMPLIFIER

Y-Amplifier ranges of 5V to 500V are selected by this control together with a pre-amplifier and a 5 Mc/s time calibration waveform already mentioned in 3.2.3. When the Y-AMPLIFIER is switched to Pre-Amp a maximum sensitivity of the order of 60 mV per cm for a bandwidth of 1 c/s to 1 Mc/s (-3 dB) is obtainable. For maximum gain of the pre-amplifier, the PRE-AMP GAIN control is turned fully clockwise.

3.2.6. Y-SHIFT VOLTS

Measurement of signal amplitude is made by the use of the dial on the Y-SHIFT VOLTS control. Half scale reading of the dial (0-25 or 0-10) is equivalent to the Y-AMPLIFIER range in use.

3.2.7. METER SWITCH

This provides facilities for testing CV2154 and CV2155 crystals, monitoring the klystron current and reflector/cathode potential, and also the crystal current from the mixer.

3.2.8. KLYSTRON CONTROLS

3.2.8.1. KLYSTRON TUNING

A mechanical control providing coarse tuning of the klystron.

3.2.8.2. KLYSTRON REFLECTOR POTENTIAL

This is a fine tuning control.

3.2.8.3. SET LEVEL

An attenuator on the waveguide panel for varying the klystron drive to the mixer.

3.2.8.4. KLYSTRON SWEEP AMPLITUDE (or SPECTRUM EXPANSION)

The klystron reflector potential is swept only on the 30, 100 and 300 millisecond time base ranges and maximum sweep is obtained when this control is set fully anti-clockwise.

3.3. OPERATING OF TEST SET

3.3.1. OSCILLOSCOPE

Set OPERATION switch - Oscilloscope.

3.3.1.1. X-TIME BASE

Positive going pulses of at least 4 volts amplitude and approximately 1 micro-second are required to trigger the time base.

Select the TIME BASE RANGE to give the required presentation.

The measurement of time is carried out by setting the start of the period to be measured under a vertical graticule line by means of the X-SHIFT TIME control, the trace being in an approximately central position. Rotate the dial to 0. Turn the X SHIFT TIME control until the end of the period to be

3.3.1.1. Contd.

measured is beneath the same graticule line. The length of the period is then read off the dial on the scale applicable.

3.3.1.2. Y-AMPLIFIER

Set INPUT SELECTOR - as required
Y AMPLIFIER - as required

The measurement of voltage amplitude is made by setting one level of the signal to be measured along a horizontal graticule line by means of the Y-SHIFT VOLTS control. Rotate the dial to 0. Turn the Y-SHIFT VOLTS control until the other level of the signal is along the selected graticule line. The signal amplitude is then read off the dial on the scale applicable.

3.3.2. SPECTRUM ANALYSER

3.3.2.1. KLYSTRON MODE

Set OPERATION - Klystron Mode
Y-AMPLIFIER - 5V
X TIME BASE 100 ms
METER Xtal 2mA FSD
KLYSTRON SWEEP AMPLITUDE or SPECTRUM EXPANSION) Fully anti-clockwise
SET LEVEL Adjusted to give about 1mA crystal current on meter.

Adjust the KLYSTRON REFLECTOR POTENTIAL and the KLYSTRON TUNING control to obtain a full klystron mode on the Display.

3.3.2.2. SPECTRUM

(Paragraph 3.3.2.1. to be carried out first).

Set	OPERATION	Analyser
	Y AMPLIFIER	Pre-Amp
	PRE-AMP GAIN	Fully clockwise

The ends of the klystron mode will break through and be observed as two spikes on the trace.

Inject the source of S band pulses to one of the two coaxial plugs on the waveguide panel. Vary the KLYSTRON TUNING control and at the same time keep the two spikes of the klystron mode central by the slight adjustment of the KLYSTRON REFLECTOR POTENTIAL control, until the spectrum of the S band pulses appears. Increase the KLYSTRON SWEEP AMPLITUDE (or SPECTRUM EXPANSION) control clockwise, adjusting, if necessary, the KLYSTRON REFLECTOR POTENTIAL control, so as to expand the 'envelope' of the spectrum. Adjust the PRE-AMP GAIN, SET LEVEL control and the output level of the S Band pulses for the optimum display.

To check the A.F.C. of the radar a sample from the local oscillator klystron may be fed to the other co-axial plug on the waveguide panel. The small spike obtained should be in the centre of the main envelope of the Spectrum, if the A.F.C. is operating satisfactorily.
NB. This is only applicable if the Radar IF is twice that of the Spectrum Analyser IF.

3.3.2.2. Contd.

The X TIME BASE may be switched to the 30 mS or 300 mS time base ranges if desired.

3.3.3. CRYSTAL TESTING

Set the METER to TEST CV2154 or CV2155 (whichever is applicable) and insert the crystal into the TEST XTAL socket. If the meter needle reads in the GREEN region, the crystal is good; or if in the RED region, it should be discarded.

The criterion taken is that for a reverse vias of 1 volt, the current is less than 100 µA.

4. PRINCIPLES OF OPERATION

The MW 69/S Spectrum Analyser consists of three major units:

1. Display Unit.
2. Waveguide Unit.
3. Power Unit.

4.1. DISPLAY UNIT

This unit divides up into four sections:

1. X-Time Base.
2. Y-Amplifier.
3. Spectrum Analyser IF Amplifier.
4. C.R.T. Circuit.

4.1.1. X-TIME BASE

Positive pulses approximately 1 microsecond wide and at least 4 volts amplitude are required to trigger the time base. They are amplified by V1 and then inverted by a pulse transformer T1. These pulses operate a bistable multivibrator V3 and V4. To reduce the effects of stray capacitances and to give a very good rise time, feed-back for the bistable multivibrator is via cathode followers. Three outputs are taken from the bistable multivibrator.

1. A negative going pulse to cut off V7, initiating the time base.
2. A positive going bright-up pulse to the grid of the C.R.T., V12.
3. A negative going pulse to trigger the 5 Mc/s time calibration waveform.

4.1.1. Contd.

V5B,V6A,V6B & V7 form a bootstrap time base circuit. V7 is the switch valve and is cut off at the start of the time base by the negative going pulse from the bistable multivibrator. V5B and V6A determine the aiming voltage and V6B is the feed-back cathode follower. When V7 is cut off, a capacitor selected by SA2 charges up through a resistor selected by SA3. The rising potential across this capacitor is fed directly to V6B grid and by cathode follower action, the cathode of this valve rises almost the same amount. Hence the voltage across the resistor remains constant and the capacitor charges up linearly producing a saw-tooth waveform. A sample of this waveform is fed back to a diode V5A such that when its anode reaches a potential of approximately -10 volts the bistable multivibrator is switched back to its other state awaiting the next trigger pulse.

The sawtooth waveform obtained at the cathode of V6B is applied to the X1 plate of the C.R.T. via an inverter valve, V8 and to the X2 plate by a further inverter valve V9. The calibrated X-Shift voltage is coupled on to the grid of V8.

With high trigger rates and slow speed time-bases, flyback time is significant. A circuit consisting of MR1, MR2 and R29, feeding back to V1 suppressor grid provides a means of trigger suppression during flyback.

On the three slow speed time bases, potentiometer RV15 is connected in series with the anode load of V8 from which is derived the klystron sweep voltage.

4.1.2.3. 5 MC/S CALIBRATE WAVEFORM

This is a pulsed Hartley oscillator. When the TIME BASE RANGE is set to 1 microsecond and the Y-AMPLIFIER set to 5 Mc/s CAL., a negative going pulse from the bistable multivibrator cuts off V21B. The tuned circuit L4, C53 oscillates and is maintained in oscillation by feedback produced by V21A. The output is coupled directly into the Y-AMPLIFIER input via Switch SB5.

4.1.3. SPECTRUM ANALYSER IF AMPLIFIER

4.1.3.1. MW 69/S MARK II/15

A tuned narrow-band amplifier V13 amplifies the output of the mixer at 15 Mc/s. The signal is detected by V14B, V14A protecting the narrow band amplifier from the detector load. The output is normally observed on the Pre-Amp range of the Y-AMPLIFIER.

4.1.3.2. MW 69/S MARK II/7

A tuned narrow band amplifier amplifies the output of the mixer at 6.75 Mc/s. The signal is then passed through a simple bridge crystal filter and detected by V14B.

4.1.4. C.R.T. CIRCUIT

The potentials of the C.R.T. (4 EPI) are provided in the conventional manner. Brilliance and focus controls are on the front panel. To correct for astigmatism,

4.1.2.3. 5 MC/S CALIBRATE WAVEFORM

This is a pulsed Hartley oscillator. When the TIME BASE RANGE is set to 1 microsecond and the Y-AMPLIFIER set to 5 Mc/s CAL., a negative going pulse from the bistable multivibrator cuts off V21B. The tuned circuit L4, C53 oscillates and is maintained in oscillation by feedback produced by V21A. The output is coupled directly into the Y-AMPLIFIER input via Switch SB5.

4.1.3. SPECTRUM ANALYSER IF AMPLIFIER

4.1.3.1. MW 69/S MARK II/15

A tuned narrow-band amplifier V13 amplifies the output of the mixer at 15 Mc/s. The signal is detected by V14B, V14A protecting the narrow band amplifier from the detector load. The output is normally observed on the Pre-Amp range of the Y-AMPLIFIER.

4.1.3.2. MW 69/S MARK II/7

A tuned narrow band amplifier amplifies the output of the mixer at 6.75 Mc/s. The signal is then passed through a simple bridge crystal filter and detected by V14B.

4.1.4. C.R.T. CIRCUIT

The potentials of the C.R.T. (4 EPI) are provided in the conventional manner. Brilliance and focus controls are on the front panel. To correct for astigmatism,

4.1.4. Contd.

anode 3 of the C.R.T. is connected to the mean of the Y plate potentials.

The bright-up pulses from V4B are coupled to the grid of the C.R.T. and are restored negatively or positively depending on the time base range in use; negatively for 1 millisecond to 300 millisecond ranges and positively for 1 microsecond to 300 microsecond ranges,

When observing the spectrum, additional brilliance is incorporated. Negative pulses from the Y-Amplifier are amplified and limited by V18A, inverted by V18B and then applied to the cathode of the C.R.T.

4.2. WAVEGUIDE UNIT

The klystron, a CV2116, is mounted in an external resonant cavity, which is tuned mechanically by a plunger. The klystron output is coupled to the mixer via a variable attenuator (SET LEVEL). Two R.A.E. co-axial sockets feed the samples into the waveguide and are mixed with the klystron output in the mixer (CV2154). The IF output (15 Mc/s or 6.75 Mc/s as the case may be) is then fed directly to the input of V13 in Display Unit.

4.3. POWER SUPPLIES

The various HT supplies are derived from a separate chassis which is mounted at the rear of the waveguide panel. The valve heater supplies for the Display Unit are derived from a transformer mounted on that unit.

4.3.1. +250V HT SUPPLY

This is a conventional series stabilised power supply, capable of producing an output of up to 200 mA. The series valve is V2; the feed back loop has a cascode amplifier V3 and the reference level voltage is obtained from V4. Less than 5 mV peak to peak ripple occurs on this supply line at full load.

4.3.2. -250V HT SUPPLY

This is similar to the +250V HT supply and capable of producing an output of up to 200 mA. Less than 5 mV peak to peak ripple occurs on this supply line at full load.

4.3.3. +370V HT SUPPLY

A current of 10 mA is drawn from the screen circuit of the series valve V3 in the +250V HT supply.

4.3.4. -505V AND -402V HT SUPPLIES

Three 85V neons V9, V10, V11 are connected in series across a voltage doubler circuit. They are referenced to the -250V HT supply. Ripple is better than 15mV on both supplies.

4.3.5. +ve AND -ve EHT SUPPLIES

Both supplies, from the same secondary winding on T3, are half-wave rectified and smoothed giving on load EHT voltages of the order of $\pm$ 1.8 KV. Ripple on the +ve EHT supply is about 5 volts peak to peak and on the -ve EHT supply 1 volt peak to peak.

5. MAINTENANCE

When removing any unit from the case, disconnect the Test Set from the mains supply.

5.1. DISPLAY UNIT

5.1.1. GENERAL

All the valves (except V10, V11 and V18) are accessible by the removal of the top panel of the case.

To change the C.R.T. remove the top panel of the case. Disconnect the valve base, the 5 side pin connectors and the P.D.A. cap. Loosen the clamps at the front and rear of the Mumetal screen. Release the four knurled captive screws retaining the hood and remove it. Remove four counter sunk screws in the escutcheon block and withdraw the C.R.T. assembly from the front of the instrument. Take off the graticule and the C.R.T. may then be gently eased out of the screen.

To remove the Display Unit, unscrew its front panel and gently slide the unit out of the case. The inter-connecting leads are long enough to allow it to be placed in front of the Test Set.

To replace the Bright-up Valve V18, slide the Display Unit about half way out of the case.

To replace the diodes V10 and V11, first remove the Display Unit from the case and the C.R.T. assembly as above and then remove four screws holding the E.H.T. panel to the chassis and gently turn the panel to a convenient angle to unsolder the defective diode.

5.1.2. TYPICAL D.C. VOLTAGES

All measurements carried out on a Model 8 Avometer.

Unless otherwise stated, set :

Y AMPLIFIER - 5V
TIME BASE RANGE - 1 mS
OPERATION - Oscilloscope
INPUT SELECTOR - A.C.
No Y AMPLIFIER INPUT
No TRIGGER INPUT

Adjust the controls for a dim spot in the centre of the tube.

TEST POINT	W.R.T.	READING (volts)	RANGE (volts)
V1 anode	Earth	-18.5	25
V1 grid	-250V HT	- 7.4	10
V2A anode	Earth	-13.5	25
V2A cathode	Earth	-13.3	25
V2B anode	Earth	-13.5	25
V2B cathode	Earth	0	25
V3A cathode	Earth	173	250
V3B anode	Earth	172	250
V4A anode	Earth	60	250
V4B cathode	Earth	65	250
V5A anode	-250V HT	135	250
V5B anode	-250V HT	14.5	25
V5B cathode	-250V HT	13.5	25
V6A anode	Earth	-48	250
V6B cathode	Earth	-43	250
V7 screen	Earth	-160	250
V8 anode	Earth	220	250
V9 anode	Earth	220	250
V10 cathode	Earth	-1800	2500
V11 anode	Earth	-1850	2500
V12 cathode	Earth	-1750	2500
V12 grid	Earth	-1800	2500
V12 anode 2	Earth	-1250	2500
V12 anode 4	Earth	1800	2500
V12 anode 3	Earth	165	250
V13 anode	Earth	240	250
V13 screen	Earth	240	250
V13 cathode	Earth	2.0	10

Table contd.

Table continued from previous page:

	TEST POINT	W.R.T.	READING (volts)	RANGE (volts)
MW 69/S Mark II/15	V14A cathode	Earth	5.0	10
	V14B cathode	Earth	5.3	10
MW 69/S Mark II/7	V14A anode	Earth	210	250
	V14A cathode	Earth	2.2	10
	V14B anode	Earth	0	10
	V14B cathode	Earth	0.35	10
	V15 anode	Earth	203	250
	V15 cathode	Earth	2.0	10
	V16 anode	Earth	205V	250
	V16 cathode	Earth	2.1	10
	V17A cathode	Earth	4.0	10
	V18A anode	Earth	233	250
	V18A grid	Earth	-1.6	10
	V18B anode	Earth	243	250
	V18B cathode	Earth	4.5	10
	V19 anode	Earth	165	250
	V19 cathode	Earth	8	10
	V20 anode	Earth	165	250
	V20 cathode	Earth	8	10

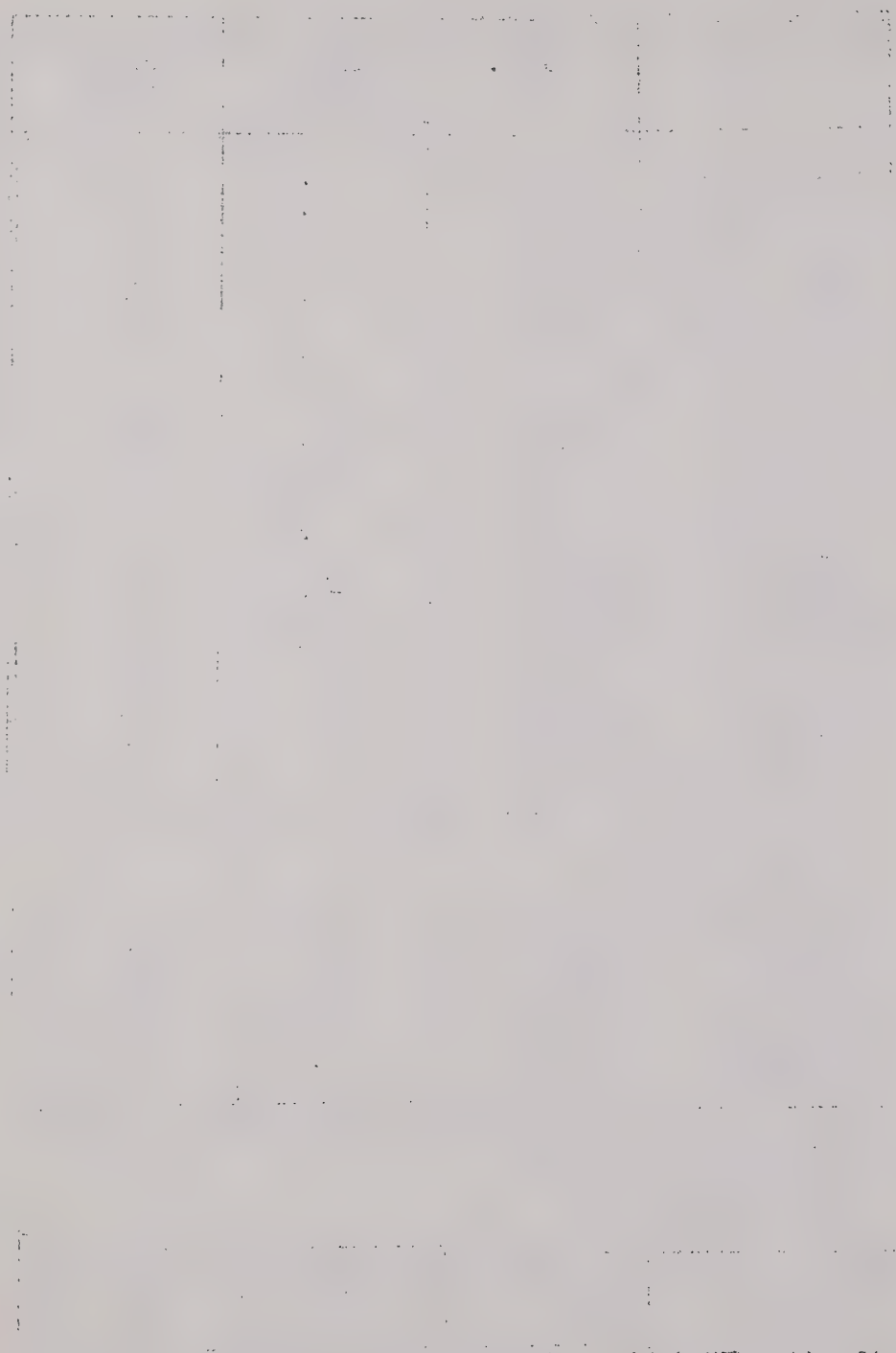
Set Y AMPLIFIER 10V

V12 anode 3	Earth	170	250
V19 anode	Earth	170	250
V19 cathode	Earth	5.5	10
V20 anode	Earth	170	250
V20 cathode	Earth	5.5	10

Set Y AMPLIFIER 5 Mc/s Cal.

TIME BASE RANGE 1μs.

V21 anode	Earth	110	250



5.1.3. TYPICAL WAVEFORMS

Waveforms of the X Time Base are shown on the circuit diagram.

5.1.4. CHANGING IF AMPLIFIER

To change to the 15 Mc/s title 6.75 Mc/s IF Amplifier (or vice versa) simply unsolder the eight links from the main chassis to the sub-unit, remove the four nuts and screws and the amplifier may be withdrawn. The other sub-unit is then fixed in position and the eight connecting links soldered on.

5.2. WAVEGUIDE UNIT

5.2.1. GENERAL

The klystron cathode current and reflector/cathode potential may be monitored by the internal meter.

To remove the waveguide unit, unscrew its front panel and gently take the unit out of the case. If necessary, disconnect the terminal strip and the coaxial connector.

5.2.2. REPLACEMENT OF KLYSTRON

Remove the waveguide unit as in 5.2.1.

Remove the reflector top cap and valve base connections. Unscrew the knurled ring at the base of the klystron and gently withdraw the valve. When replacing the klystron into the waveguide slip the valve seat over the reflector top cap and fit it on to the metal cavity nearer the valve base. Ease the klystron back into the waveguide. Replace the knurled ring, top cap and valve base connections.

5.2.2. Contd.

The klystron cathode voltage should be -250 volts and the reflector/cathode voltage should swing between 70V and 170V.

5.3. POWER UNIT

5.3.1. GENERAL

All the valves (except V4 and V8) are accessible by the removal of the back panel of the case. V4 and V8 are wired-in stabiliser valves located inside the chassis.

To remove the Power Unit, the Waveguide Unit must be removed first (as described in 5.2.1.). Disconnect terminal strips TS1 and TS2 and pull out the +ve and -ve E.H.T. sockets. Unscrew the Power Unit chassis and withdraw it from the case.

5.3.2. TYPICAL VOLTAGES

Connect a chain of five 470K ohm 1 watt resistors (ERIE Type 8 or Morganite Type Y) between earth and the -ve E.H.T. supply.

All other supplies to be left unloaded.

Measurements carried out on a Model 8 Avometer.

See Table on following page.

A.C. VOLTAGES

TEST POINT	W.R.T.	READING (volts)	RANGE (volts)
V1 anodes	Earth	350	1000
V5 anodes	-250V HT	350	1000

D.C. VOLTAGES

V2 anode	Earth	480	1000
V2 screen	Earth	480	1000
V2 grid	+250V HT	-57	250
V2 cathode	Earth	250	250
V3A grid	Earth	140	250
V3A cathode	Earth	141	250
V3B grid	Earth	85.5	250
V3B cathode	Earth	86	250
V6 anode	-250V HT	480	1000
V6 screen	-250V HT	480	1000
V6 grid	Earth	-57	250
V6 cathode	-250V HT	250	250
V7A grid	-250V HT	140	250
V7A cathode	-250V HT	141	250
V7B grid	-250V HT	85.5	250
V7B cathode	-250V HT	86	250
V9 cathode	-250V HT	-85	250
V10 cathode	-250V HT	-170	250
V11 cathode	-250V HT	-255	1000
Junction of C13, R30, R31 and R32	-250V HT	19	100
+ve EHT Supply	Earth	1800	2500
-ve EHT Supply	Earth	-1750	2500

6. SETTING UP PROCEDURE

6.1. POWER UNIT

On the 50 c/s mains supply tagstrip TS1 (normally connected to the Display Unit) temporarily link together terminal 6 to terminal 9 and also terminal 7 to terminal 8.

Adjust the mains selector to the supply voltage.

A substandard voltmeter must be used when adjusting the HT supplies.

6.1.1. +250V HT SUPPLY

Connect a 170 mA load across the +250V HT supply and earth (terminals 2 and 3).

Adjust RV1 to give +250V with respect to earth at this loading.

6.1.2. -250V HT SUPPLY

Connect a 100 mA load across the -250V HT supply and earth (terminals 3 and 4).

Adjust RV2 to give -250V with respect to earth at this loading.

6.2. DISPLAY UNIT

Unless otherwise stated, the undermentioned controls to be set as follows :

Set INPUT SELECTOR	A.C.
OPERATION	Oscilloscope
Pre-set Controls RV1 to RV11	Temporarily set to the maximum anticlockwise position.
Pre-set Controls RV12 and RV14	Temporarily set to about the mid-way position.

The trigger input pulse to be between +5 and +20 volts amplitude 1µsec wide at a repetition frequency of 1000 pps.

6.2.1. X TIME BASE

6.2.1.1. ADJUSTMENT OF VC1

Set TIME BASE RANGE 100µs

Temporarily remove the flylead connected to the X2 plate of the C.R.T. and connect the X2 plate to the +250V HT supply. Switch the TIME BASE RANGE in turn to the 30µs, 10µs, 3µs and 1µs positions and adjust the trimmer VC1 until the length of the trace is, as near as possible constant through the ranges. Note that the time base trace will appear to be only about 4 cm. long.

Finally, reconnect the X2 Plate up as per circuit.

6.2.1.2. ADJUSTMENT OF VC2

Set TIME BASE RANGE 100µs

Note the length of the time base trace (between $8\frac{1}{4}$ cms and $9\frac{1}{2}$ cms long) and switch the TIME BASE RANGE control to the 30µs, 10µs 3µs and 1µs positions and adjust the trimmer VC2 until the length of the trace is, as near as possible, constant throughout.

6.2.1.3. ADJUSTMENT OF RV12 AND RV14

Set TIME BASE RANGE 100µs

Rotate the X SHIFT TIME CONTROL fully clockwise and anticlockwise and observe the amount of trace visible in both cases. If more trace is seen on the left of the screen than on the right, slightly rotate RV12 in an anticlockwise and RV14 in a clockwise direction. Similarly, if more trace is seen on the right of the screen than on the left, slightly rotate RV12 in a clockwise and RV14 in an anticlockwise direction.

To the Y Amplifier, set to a suitable range, apply a train of pulses 1µs apart, each tenth pulse of slightly greater amplitude, each hundredth pulse of still greater amplitude and so on. Such a train of pulses may be obtained from a MW 67 Test Set. Trigger the time base with the 1 msec. period pulses (via a Solartron Pulse Generator Type OPS 100C, or similar type generator,) to obtain a synchronised trigger pulse.

6.2.1.3. Contd.

Place the time base trace symmetrically across the screen. Rotate the X SHIFT TIME control in an anticlockwise direction.and measure the apparent time for ten 10μs pulses by counting 10 pulses past any particular graticule line on the left hand side of the screen. Repeat this procedure for the time base ranges listed below. For convenience use the 0-10 scale on the X SHIFT TIME control throughout.

TIME BASE RANGE	PULSE PERIODS TO BE OBSERVED
1μs	1 at 1μs
3μs	3 at 1μs
10μs	10 at 1μs
30μs	3 at 10μs
100μs	10 at 10μs
300μs	3 at 100μs
1ms	10 at 100μs
3ms	3 at 1ms

Set TIME BASE RANGE 30ms.

To the Y Amplifier set to a suitable range apply the output from the STANDARD FREQUENCIES socket of a Venner TSA 1035P Frequency and Time Measurement unit, the TIME UNIT SELECTOR set to 10 ms. This output is also used to trigger the time base (via Solartron Pulse Generator Type OPS 100C or similar type Generator) to obtain a synchronised trigger pulse.

6.2.1.3. Contd.

Using the same procedure as for the high speed time bases, measure the apparent time for three 10ms pulses past any particular graticule line on the left hand side of the screen.

This procedure is to be carried out for the time base ranges listed below :

TIME BASE RANGE	PULSE PERIODS TO BE OBSERVED
30ms	3 at 10 ms
100ms	10 at 10 ms
300ms	3 at 100ms

NB. The Venner Frequency and Time Measuring Unit TS 1035P may, if desired, be used on the 300µs, 1ms and 3ms time base ranges, with the appropriate adjustment of the TIME UNIT SELECTOR.

From these readings set the TIME BASE RANGE control to the range which gave the lowest number of scale divisions on the X SHIFT TIME control.

Place the time base trace symmetrically across the screen. Rotate the X SHIFT TIME control anticlockwise and measure the apparent time for the specified number of pulses listed in the table above past any particular graticule line on the left hand side of the screen.

6.2.1.3. Contd.

Return the trace to the central position and repeat, rotating the X SHIFT TIME control clockwise and counting the pulses past any particular graticule line on the right hand side of the screen. Measure again the apparent time for this train of pulses and average the two results obtained. If the result is more than 10 scale divisions rotate RV12 and RV14 slightly clockwise. Similarly if less, rotate RV12 and RV14 slightly anti-clockwise. The apparent time for the train of pulses should be within $\pm$ 3% of 10 scale divisions. Check that when the X SHIFT TIME control is rotated clockwise and anticlockwise an equal amount of trace is observed on the screen and when the control is in the half way position, the trace approximately central.

6.2.1.4. ADJUSTMENT OF PRE-SET CONTROLS RV1 TO RV11

Set TIME BASE RANGE 1µs (provided this was not set up in 6.2.1.3.)

Place the time base trace symmetrically across the screen. Rotate the X SHIFT TIME control in an anticlockwise direction and measure the apparent time between the 1µs pulses. Repeat procedure rotating the X SHIFT TIME control in a clockwise direction and again measure the apparent time between pulses. Average the two results, which should be more

6.2.1.4. Contd.

than 1µs. Adjust the pre-set control RV1 until the average reading is 1µs. Repeat this procedure for the following time base ranges using the pre-set controls stated.

N.B. The Venner Frequency and Time Measuring Unit TSA 1035P will be used for the slower time base ranges.

TIME BASE RANGE	PRE-SET CONTROL	PULSE PERIODS TO BE OBSERVED
1µs	RV1	1 at 1µs
3µs	RV2	3 at 1µs
10µs	RV3	10 at 1µs
30µs	RV4	3 at 10µs
100µs	RV5	10 at 10µs
300µs	RV6	3 at 100µs
1ms	RV7	10 at 100µs
3ms	RV8	3 at 1ms
30ms	RV9	3 at 10ms
100ms	RV10	10 at 10ms
300ms	RV11	3 at 100ms

In all cases, the clockwise and anticlockwise readings should be within $\pm$ 3% of the real time.
N.B. The pre-set control for the TIME BASE RANGE set up in 6.2.1.3. is left in the maximum anticlockwise position.

6.2.2. VARIATION OF Y SHIFT

Set Y-AMPLIFIER 50V

Y SHIFT VOLTS mid-way position.

Observe that the trace lies approximately along the centre graticule line. Switch the Y AMPLIFIER control to the 25V, 10V and 5V ranges and note that the trace is between ± 1cm of the centre graticule line without adjusting the Y SHIFT VOLTS control from the mid-way position. If, however, the time base trace has shifted more than ±1cm from the central position, interchange V19 and V20. Now, if the effect is the reverse then it is due to two very dissimilar valves, which should be replaced.

6.2.3. 5 MC/S CALIBRATION COIL

Set TIME BASE RANGE 1μs

Y AMPLIFIER 5 Mc/s CAL.

Temporarily connect between V21B grid and the -250 Volt HT Supply a 3.9 M ohm. ¼ watt resistor. Also connect the aerial socket of a BC 221 Wavemeter via a 47 pF capacitor to the Y2 plate of the Display Unit.

Adjust the tuning plunger of L4 such that a frequency of 5 Mc/s ± 25 Kc/s is measured on the wavemeter.

N.B. As the crystal check point of the BC 221 Wavemeter is at 2.5 Mc/s care must be taken that the coil is set up on the second harmonic and not any other. Remove the 3.9 M ohm resistor and the 47 pF capacitor used for setting up the coil. Observe the sinewave on the screen and check that the average apparent time for 5 cycles is 1μs.

6.2.4. SPECTRUM ANALYSER IF AMPLIFIER

6.2.4.1. 15 MC/S IF

Set	Y AMPLIFIER	Pre Amp
	OPERATION	Spectrum
	TIME-BASE RANGE	30 ms
	PRE-AMP GAIN	Maximum

Connect the co-axial lead which normally fits in the MIXER OUTPUT socket to a signal generator, Marconi Type T.F. 801A, the frequency of which has been set at 15 Mc/s by means of the BC221 wavemeter. Amplitude modulate the 15 Mc/s by 400 c/s at 50%. Set the attenuator of the signal generator to 40 dBs. Adjust trimmer VC4 to obtain maximum amplitude on the screen.

6.2.4.2. 6.75 MC/S IF

Set	Y AMPLIFIER	Pre-Amp
	OPERATION	Spectrum
	TIME BASE RANGE	30 msec.
	PRE-AMP GAIN	Maximum

Suitable signal generators are the Marconi TF114G or TF995A (series). Set the frequency to 6.75 Mc/s by the BC221 Wavemeter. Amplitude modulate the 6.75 Mc/s by 400 c/s (or 1 Kc/s) at a depth of 40%. Terminate the output of the signal generator in 68 ohms and set the output to 100 mV R.M.S.

6.2.4.2. Contd.

Disconnect LINK 1 to the Spectrum Analyser sub-unit and remove V13. Connect the signal generator output to the grid of V14A. Set VC4 to minimum capacitance and then vary VC5 to obtain maximum signal on the screen. Using the incremental frequency dial, adjust VC4 until the response to ± 40 Kc/s of the peak output is symmetrical.

Remove the signal generator and replace LINK 1 and V13.

Connect the signal generator (25 mV R.M.S. terminated in 68 ohm) to the MIXER INPUT. Adjust VC3 to give maximum signal on the screen at 6.75 Mc/s.

6.2.5. Y AMPLIFIER. FREQUENCY RESPONSE

NB. A suitable generator is the Marconi TF885A/1. In this case use the 10V range of the generator and temporarily connect a 330 ohms ¼W resistor across the input socket of the Display Unit while carrying out the adjustment.

6.2.5.1. TRIMMER VC10

Set	OPERATING SWITCH	Oscilloscope
	Y AMPLIFIER	50V
	TIME BASE RANGE	100 µs.

To the Y AMPLIFIER apply a sinewave of about 20V peak to peak amplitude. Vary the

6.2.5.1. Contd.

frequency from 100 c/s to 12 Mc/s and measure the output using the Y SHIFT volts scale. Adjust VC10 to obtain a maximally flat response, the -3 dB point to be greater than 10 Mc/s.

6.2.5.2. TRIMMERS VC7, VC8 AND VC9

To the Y AMPLIFIER apply a sinewave of at least 20V peak to peak amplitude. Vary the frequency from 100 c/s to 12 Mc/s and measure the output using the Y SHIFT scale. Adjust the appropriate trimmers to obtain a maximally flat response, the -3 dB point to be greater than 10 Mc/s.

RANGE	TRIMMER
100V	VC7
250V	VC8
500V	VC9

6.3. MICROWAVE UNIT

6.3.1. SET LEVEL ATTENUATOR ADJUSTMENT

To be examined before assembly to the front panel. With the attenuator drive adjusted for minimum insertion the attenuator vane is to be just in contact with the waveguide wall.

6.3.2. MATCH OF MIXER

To be examined before assembly to the front panel. With the mixer connected to a WG10 standing wave-meter and the two coaxial plugs correctly terminated, the RF drive to the mixer at 3,000 Mc/s is adjusted to produce a crystal current of 1 mA measured on the 10 mA range of a Model 8 Avometer, the V.S.W.R. should then be of the order of 0.5.1.

6.3.3. CALIBRATION OF KLYSTRON TUNING CONTROL

Set	OPERATION	Klystron Mode
	Y AMPLIFIER	5V
	KLYSTRON SWEEP AMPLITUDE (or SPECTRUM EXPANSION)	Maximum clockwise position.

The CW output of a MW40A/S oscillator is injected into the mixer via the L.O. Sample Plug. The output from the MW40A/S is then increased and the frequency altered until the beat pattern is seen on the C.R.T. The oscillator frequency at which this occurs is found from the wavemeter on the oscillator. Measurements are to be carried out at frequencies of 2.7, 2.75, 2.8, 2.85, 2.9, 3.0 and 3.1 KMc/s and the dial marked accordingly.

6.4. TEST EQUIPMENT REQUIRED

See 7.4.

7. TEST SPECIFICATION

7.1. POWER UNIT

On the Tagstrip TS1 (normally connected to the Display Unit) temporarily link together terminal 6 to terminal 9 and also terminal 7 to terminal 8.

On Tagstrip TS2, temporarily link terminal 3 to the chassis.

Adjust the mains selector to the supply voltage.

A sub-standard voltmeter must be used when checking all the HT supplies except the +ve and -ve E.H.T. supplies, when an Avometer Model 8 may be used.

7.1.1. +250V AND -250V HT SUPPLIES

Temporarily connect in series a 22 K ohm and an 18 K ohm resistor (Welwyn AW3112, 6 watt) between terminals 1 and 3 on Tagstrip TS2.

To the following HT supplies, in turn, connect a variable load to earth. Vary this load from 0-200mA and note that the HT supplies do not change by more than that shown.

Observe that the ripple does not exceed that quoted.

HT SUPPLY	MAX. CURRENT VARIATION	MAX. HT VARIATION	MAXIMUM RIPPLE (Peak to Peak)
+250V	0 to 200 mA	250V to 249.5V	5 mV
-250V	0 to 200 mA	-250V to -249.5V	5 mV

7.1.1. Contd.

Set the load on the +250V HT supply to 175 mA and measure the voltage across terminals 1 and 3 on tagstrip TS2. This voltage should be between 360V and 380V.

7.1.2. -420V, -505V and +ve E.H.T. SUPPLIES

Check that these HT supplies, on no load, are within the limits shown below.

Observe that the ripple does not exceed that quoted.

NB. When observing the ripple on the +ve E.H.T. supply, connect a 1µF 2.5 KV working capacitor between the supply and input to the oscilloscope and a 1 M ohm ¼W 10% resistor from the oscilloscope input to earth.

HT LINE	HT LINE VARIATION	MAX. RIPPLE (peak to Peak)
-420V	-425V to -415V	15mV
-505V	-510V to -500V	15mV
+ve EHT	+1.7KV to +2.0KV	7.5mV

7.1.3. -ve E.H.T. SUPPLY

Connect a resistance chain consisting of five 470K ohms resistors (ERIE Type 8 or Morganite Type Y) in series between the -ve E.H.T. supply and earth and measure the E.H.T. which should be between -1.6 KV and -1.9 KV. Connect a 1µF 2.5 KV working capacitor between the negative E.H.T. supply and the input to an oscilloscope and a 1 M ohm ¼W 10% resistor from the oscilloscope input to earth. Observe that the ripple does not exceed 1.25 volts peak to peak when on load.

7.2. DISPLAY UNIT

Unless otherwise stated, the undermentioned controls to be set as follows:

OPERATION	Oscilloscope
INPUT SELECTOR	A.C.
METER	Shorted

The trigger pulse is to be between +5V and +20V amplitude 1µs wide at a recurrence frequency of 1000 pps.

7.2.1. PICTURE SHARPNESS

To the Y AMPLIFIER, set to the 10V Range, apply a 1 Kc/s sinewave of suitable amplitude and synchronised with the trigger pulse. Set the TIME BASE RANGE to 3 ms, and rotate the X and Y SHIFT controls so that the trace is central. By only adjusting the FOCUS control, check that a sharp picture is obtained free from astigmatism (i.e. focussed in the X and Y planes).

Set the Y AMPLIFIER to the 5V range and adjust the 1 Kc/s sinewave to a suitable amplitude. With only a slight adjustment of the FOCUS control, if necessary, check that a perfectly sharp picture is again obtained.

7.2.2. X TIME BASE

7.2.2.1. CORRECT ADJUSTMENT OF VC1

Set TIME BASE RANGE 100µs

Temporarily remove the flylead connected to the X2 plate of the C.R.T. and connect the X2 plate to the +250V HT Supply. Switch the TIME BASE RANGE control, in turn, to the 30µs, 10µs, 3µs and 1µs positions. Check that the length of the trace does not alter by more than $\frac{1}{4}$ cm throughout. Note that the time base trace will appear to be only about 4 cms long.

Finally re-connect the X2 Plate as per circuit and seal the trimmer VC1.

7.2.2.2. CORRECT ADJUSTMENT OF VC2

Set TIME BASE RANGE 100µs

Note the length of the time base trace (between $8\frac{1}{4}$ cms and $9\frac{1}{2}$ cms long) and switch the TIME BASE RANGE control, in turn, to the 30µs, 10µs, 3µs and 1µs positions and note that the length of the trace does not vary by more than $\frac{1}{4}$ cm throughout.

Finally seal the trimmer VC2.

7.2.2.3. LINEARITY TEST OF X TIME BASE (1us - 3ms RANGES)

Set TIME BASE RANGE 100µs

Rotate the X SHIFT TIME control fully clockwise and anticlockwise and observe that the amount of trace visible in both cases is approximately the same. Not more than a $\frac{1}{2}$ cm difference should be seen.

Rotate the X SHIFT TIME control to the midway position and check that the trace is approximately central.

To the Y AMPLIFIER, set to a suitable range, apply a train of pulses 1µs apart, each tenth pulse of slightly greater amplitude, each hundredth pulse of still greater amplitude and so on. Such a train of pulses may be obtained from a MW 67 Test Set. Trigger the time base with the 1 msec period pulses (via a Solartron Pulse Generator Type OPS 100c, or similar type of generator) to obtain a synchronised trigger pulse.

Place the time base trace symmetrically across the screen. Rotate the X SHIFT TIME control in an anticlockwise direction and measure the apparent time for ten 10µs pulses by counting 10 pulses past any particular graticule line on the left hand side of the screen. Return the trace to the central position and repeat, rotating the X SHIFT

7.2.2.3. Contd.

TIME control clockwise counting 10 pulses past any particular graticule line on the right hand side of the screen. Measure again the apparent time for ten 10µs pulses.

This procedure is to be carried out on the undermentioned time base ranges using the recommended pulse trains.

TIME BASE RANGE	PULSE PERIOD TO BE OBSERVED
1µs	1 at 1µs
3µs	3 at 1µs
10µs	10 at 1µs
30µs	3 at 10µs
100µs	10 at 10µs
300µs	3 at 100µs
1ms	10 at 100µs
3ms	3 at 1ms

In all cases, the apparent time measured by rotating the X SHIFT TIME control clockwise and anticlockwise should be within $\pm$ 3% of the real time.

7.2.2.4. LINEARITY OF X TIME BASE (30ms, 100ms and 300ms RANGES)

Set TIME BASE RANGE 30 ms.

To the Y Amplifier, set to a suitable range, apply the output from the STANDARD FREQUENCIES socket of a Venner TSA 1035P Frequency and Time

7.2.2.4. Contd.

Measuring Unit, the TIME UNIT SELECTOR set to 10ms. This output is used to trigger the time base (via a Solartron Pulse Generator Type OPS 100C or similar type generator) to obtain a synchronised trigger pulse.

Using the same procedure as for the high speed time bases, measure the apparent time for three 10ms pulses past any particular graticule line on the left hand side of the screen and again for the right hand side.

This procedure is to be carried out for the time base ranges listed below:

TIME BASE RANGE	PULSE PERIODS TO BE OBSERVED
30ms	3 at 10ms
100ms	10 at 10ms
300ms	3 at 100ms

NB. The Venner Frequency and Time Measuring Unit TSA 1035P, may, if desired be used on the higher speed time base ranges, with the appropriate adjustment of the TIME UNIT SELECTOR.

In all cases, the apparent time measured by rotating the X SHIFT TIME control clockwise and anticlockwise should be within $\pm$ 3% of the real time.

7.2.2.4. Contd.

Finally seal the Pre-Set controls RV1 to RV12 and RV14.

7.2.3. 5 Mc/s CALIBRATION WAVEFORM

Set	Y AMPLIFIER	5 Mc/s CAL.
	X TIME BASE	1µs

Temporarily connect between V21B grid and the -250V HT supply a 3.9M ohm $\frac{1}{4}$W resistor. Also connect the aerial socket of a BC221 Wavemeter via a 47pF capacitor to the Y2 plate of the C.R.T.

Check that a frequency of 5 Mc/s $\pm$ 25 Kc/s is measured on the wavemeter and then remove the 3.9 M ohms resistor and the 47 pF capacitor.

Observe the waveform on the screen, which should be roughly of constant amplitude and about $\frac{1}{2}$ cm in height and that the maximum and minimum amplitude along the trace should not vary by more than a ratio of 1.5:1. Check that the average apparent time for 5 cycles is 1µs.

Finally, seal the plunger of L4.

7.2.4. TRIGGER PULSE AMPLITUDE

Set	X TIME BASE	1ms.

7.2.4. Contd.

Keeping the trigger pulse width and recurrence frequency constant (i.e. 1µs at 1000 pps) vary the pulse amplitude from + 4V to +20V. Observe that the time base trace is always present.

7.2.5. VARIATION OF Y SHIFT

Set	Y AMPLIFIER	50V
	Y SHIFT VOLTS	Mid-way position

Observe that the trace is approximately along the centre graticule line. Switch the Y AMPLIFIER control to the 25V, 10V and 5V ranges and note that the trace lies between $\pm$ 1cm of the centre graticule line without altering the Y SHIFT VOLTS control.

7.2.6. FREQUENCY RESPONSE OF Y AMPLIFIER

Set INPUT SELECTOR D.C.

For all Y AMPLIFIER ranges excluding the Pre-Amplifier.

To the INPUT socket apply a sinewave of suitable amplitude. The signal need not be synchronised with the trigger pulse. It is suggested that a fairly fast time base range be used.

Suggested Equipment

Y AMPLIFIER. 5V and 10V ranges

10 c/s - 100 Kc/s Wayne Kerr A.F. Oscillator Type S121

10 Kc/s - 10 Mc/s Wayne Kerr Video Oscillator Type 022B

7.2.6. Contd.

NB. Marconi Video Oscillator TF 885A/1 may be used if the above signal generators are not available.

Y AMPLIFIER. 25V to 500V Ranges

100 c/s - 12 Mc/s Marconi Video Oscillator TF 885A/1.

NB. It is advisable to terminate the output of this Oscillator at the Display Unit in the output impedance of the Oscillator on the range in use.

Plot output (using Y SHIFT VOLTS scale) against frequency (from 100 c/s upwards) for each range.

Observe that the responses obtained are maximally flat and do not rise by more than +1 dB at the high frequency end and the -3 dB point is within specification. As a guide to performance a second column of upper -3 dB points is quoted to which the equipment should meet.

RANGE	SPECIFICATION (-3 dB point)	UPPER -3 dB Point Obtainable
5V	1 Mc/s	1 Mc/s
10V	2 Mc/s	5 Mc/s
25V	5 Mc/s	>12 Mc/s
50V	10 Mc/s	>12 Mc/s
100V	10 Mc/s	>12 Mc/s
250V	10 Mc/s	>12 Mc/s
500V	10 Mc/s	>12 Mc/s

Finally seal trimmers VC7, VC8, VC9 and VC10.

7.2.7. GAIN AND FREQUENCY RESPONSE OF PRE-AMPLIFIER

Set	Y AMPLIFIER	Pre-Amp
	INPUT SELECTOR	D.C.
	PRE-AMP GAIN	Maximum clockwise rotation

To the INPUT socket, apply a sinewave of 200mV peak to peak. Plot the output (using the 5-0-5 scale on the Y SHIFT VOLTS control) against frequency (0.5 c/s to 2 Mc/s). The response obtained should be flat from 5 c/s to 200 Kc/s with -3 dB points at below 1 c/s and above 1 Mc/s. Check that the Pre-Amplifier has a gain between 9.5 and 10.5 i.e. 200 mV input should read 2 divisions on the 5-0-5 scale of the Y SHIFT VOLTS control.

Suggested Equipment

0.1 c/s - 100 c/s Dawe wide range oscillator type 400C.

10 c/s - 100 Kc/s Wayne Kerr A.F. Oscillator type S121.

10 Kc/s - 10 Mc/s Wayne Kerr video oscillator type 022B.

N.B. Marconi video oscillator. TF 885A/1 may be used if the Wayne Kerr oscillators are not available.

7.2.8. LINEARITY OF Y AMPLIFIER

Set	INPUT SELECTOR	D.C.
	TIME BASE RANGE	1 ms.

Connect a source of D.C. volts to the INPUT socket. Vary the input volts over the ranges listed in the table overleaf.

7.2.8. Contd.

Compare the input volts against the volts measured on the Y SHIFT volts scale. Use the centre graticule line as the reference line.

N.B. A sub-standard voltmeter must be used for measuring the input voltage.

Y AMPLIFIER RANGE	INPUT VOLTS W.R.T. EARTH	Y AMPLIFIER RANGE	INPUT VOLTS W.R.T. EARTH
5V	0V +2.5V +5.0V -2.5V -5.0V	100V	0V +50.0V +100.0V -50.0V -100.0V
10V	0V +5.0V +10.0V -5.0V -10.0V	250V	0V +125.0V +250.0V -125.0V -250.0V
25V	0V +12.5V +25.0V -12.5V -25.0V	500V*	0V +250V +500V -250V -500V
50V	0V +25.0V +50.0V -25.0V -50.0V	* If a 500V D.C. Supply is not available, check the 500V range using these voltage figures: 0V +125V +250V -125V -250V	

7.2.8. Contd.

The percentage error is defined as:

$$\frac{\text{D.C. INPUT VOLTS - Y SHIFT SCALE READING}}{\text{D.C. INPUT VOLTS}} \times 100$$

which must be less than $\pm$ 3% for all readings.

7.2.9. SENSITIVITY OF Y AMPLIFIER

For Y AMPLIFIER RANGES 5V, 10V, 25V and 50V
NO SIGNAL INPUT.

Set the time base trace along the graticule line 2 cms above the centre. Adjust the dial on the Y SHIFT VOLTS control to 0. Rotate the Y SHIFT VOLTS control until the time base trace is along the graticule line 2 cms below the centre. Note the voltage swing on the dial for the range applicable, and divide the result by four to obtain the sensitivity. The sensitivities for the various ranges are listed below.

RANGE	SENSITIVITY
5V	0.5 - 0.7 V/cm
10V	1.1 - 1.5 V/cm
25V	2.5 - 3.5 V/cm
50V	5.0 - 7.0 V/cm

7.2.10. CRYSTAL TEST

Connect a 10 K ohm low wattage resistor (accurate to ± 5%) across the Test Xtal socket. Switch Meter to TEST CV2154 and then to TEST CV2155. The meter needle should be reading between 9.5 and 11.0 on the scale. Remove the 10 K ohm resistor.

Insert the TEST XTAL socket, the CV2154 crystal from the mixer. Set METER to TEST CV2154 and observe that the needle should be reading in the green region.

7.2.11. METER CALIBRATION

7.2.11.1. KLYSTRON REFLECTOR VOLTAGE

Set METER Reflector Potential 200V

KLYSTRON REFLECTOR VOLTS Maximum clockwise rotation.

Connect a sub-standard voltmeter between the -250V and -420V HT supplies. The display unit meter should be reading within 5% of the true voltage.

Turn the KLYSTRON REFLECTOR VOLTS control to minimum, the meter reading should be less than 70V (7 ON SCALE).

7.2.11.2. CRYSTAL CURRENT

Set METER Xtal Current 2mA.

Temporarily remove the MIXER OUTPUT coaxial cable from the waveguide. Using a source of low D.C. volts (e.g. $1\frac{1}{2}$V from a bias battery of an Avometer) connect to the positive side a 1 K ohm potentiometer (at maximum resistance setting) in series with a Model 8 Avometer (set to the 10 mA range). Connect the other end of the Avometer to the junction of C30 and R69 and connect the negative side of the battery to earth. Reduce the resistance of the potentiometer until 2 mA is read on the DISPLAY UNIT METER (20 on scale). The Avometer reading should likewise be 2mA $\pm$ 200µA.

Finally, reconnect coaxial cable to the waveguide.

7.2.11.3. KLYSTRON CURRENT

Set METER Resonator Current 40mA
OPERATION Klystron Mode

Temporarily remove the valve base socket to the Klystron. Connect in series between terminals 3 and 6 on the waveguide a 6.8 K ohm Welwyn AW3112 resistor and an Avometer set to the 100mA range. Observe

7.2.11.3. Contd.

that the Avometer and the DISPLAY UNIT METER readings are within ± 10% of each other.

Finally, remove the resistor and Avometer and reconnect the klystron valve base socket.

7.2.12. BANDWIDTH MEASUREMENT OF SPECTRUM ANALYSER IF AMPLIFIER

7.2.12.1. 15 Mc/s IF

SET	OPERATION	Spectrum
	Y AMPLIFIER	Pre-Amp
	TIME BASE RANGE	30 mS
	PRE-AMP GAIN	Maximum
	METER	Shorted

Connect the coaxial lead which normally fits in the MIXER OUTPUT socket to a signal generator, Marconi type TF801A, the frequency of which has been set at 15 Mc/s by means of the BC221 Wavemeter. Modulate the 15 Mc/s by 400 c/s at 50%. Set the attenuator of the signal generator to 40 dBs. Observe that maximum amplitude occurs on the screen at 15 Mc/s ± 10 Kc/s. Adjust the attenuator such that about 4 cms deflection is observed on the screen. The attenuator setting should be between 40 dBs and 44 dBs. By means of the incremental frequency dial on the signal generator, measure the bandwidth of the

7.2.12.1. Contd.

analyser circuit to the -3dB point (i.e. to 0.7 of the maximum amplitude using the graticule scale). The bandwidth obtained should be less than 100 Kc/s.

Finally seal trimmer VC6.

7.2.12.2. 6.75 Mc/s IF

Set	OPERATION	Spectrum
	Y AMPLIFIER	Pre-Amp
	TIME BASE RANGE	30mS
	PRE-AMP GAIN	Maximum
	METER	Shorted

Suitable signal generators are the Marconi TF 144G or TF995A (series). Set the frequency to 6.75 Mc/s by the BC221 Wavemeter. Modulate the 6.75 Mc/s by 400 c/s (or 1 Kc/s) at 40%. Terminate the output of the signal generator in 68 ohms and set the output to 25 mV RMS.

Connect the signal generator to the MIXER INPUT. Observe that maximum amplitude occurs on the screen at 6.75 Mc/s $\pm$ 10 Kc/s and is about $3\frac{1}{2}$ cms deflection. By means of the incremental frequency dial on the signal generator, measure the bandwidth of the analyser circuit to the -3 dB point (i.e. to 0.7 of the maximum amplitude using the graticule lines) and note that the

7.2.12.2. Contd.

-3dB points are less than 20 Kc/s apart and are equidistant from the centre frequency of 6.75 Mc/s,

7.2.13. OSCILLOSCOPE

Set	TIME BASE RANGE	1µs
	Y AMPLIFIER	5 Mc/s CAL

Temporarily adjust trigger PRF to 250 pps.

Observe that the waveform is of sufficient brightness and the FOCUS control is not set to an extreme position.

7.3. MICROWAVE COMPONENTS

7.3.1. RANGE OF SET LEVEL ATTENUATOR

Set	OPERATION	Klystron Mode
	Y AMPLIFIER	5V
	KLYSTRON SWEEP AMPLITUDE (or SPECTRUM EXPANSION)	Maximum clockwise position.
	METER	Xtal Current 2mA

The SET LEVEL attenuator must have a maximum attenuation sufficient at all frequencies in the band 2.7 - 3.1 KMc/s, to reduce the crystal current of the mixer to at least 0.5 mA.

7.3.2. POWER AND FREQUENCY OF KLYSTRON OSCILLATOR

Set	OPERATION	Klystron Mode
	KLYSTRON SWEEP AMPLITUDE (or SPECTRUM EXPANSION)	Maximum clockwise position
	METER	Xtal Current 2mA

The RF power from the oscillator should be capable of producing more than 2 mA crystal current in the mixer over a band 2.7 KMc/s - 3.1 KMc/s at minimum attenuation setting of the SET LEVEL attenuator.

7.3.3. CALIBRATION OF KLYSTRON TUNING CONTROL

Set	OPERATION	Klystron Mode
	Y AMPLIFIER	5V
	KLYSTRON SWEEP AMPLITUDE (or SPECTRUM EXPANSION)	Maximum clockwise position

The CW output of an MW40A/S oscillator is injected into the mixer via the L.O. Sample Plug.

The output from the S band oscillator is then increased and the frequency altered until the beat pattern is seen on the C.R.T. The oscillator frequency at which this occurs is found from the wavemeter on the oscillator. This check is to be carried out at frequencies of 2.7 KMc/s, 2.75 KMc/s, 2.8 KMc/s, 2.85 KMc/s, 2.9 KMc/s, 3.0 KMc/s and 3.1 KMc/s. Their corresponding positions on the klystron tuning dial are to be checked.

7.3.4. KLYSTRON MODE WIDTH

Set		
	OPERATION	Klystron Mode
	Y AMPLIFIER	5V
	KLYSTRON SWEEP AMPLITUDE (or SPECTRUM EXPANSION)	Maximum anti-clockwise position.
	X TIME BASE	100 mS

With the klystron mode displayed on the C.R.T., the SET LEVEL attenuator is adjusted to give the klystron mode a height of 2 cm on the C.R.T. The CW output of a MW 40A/S oscillator is then injected into the mixer via the L.O. Sample plug and its frequency and output adjusted until the oscillator 'pip' is visible on the klystron mode. The frequencies corresponding to the two half power points (1 cm height) on the klystron mode are then found from the wave-meter mounted on the S Band oscillator. The mode width should be at least 25 Mc/s when measured at 2.7, 2.9 and 3.1 KMc/s.

7.3.5. OVERALL CHECK OF SPECTRUM ANALYSER

Set		
	OPERATION	Klystron Mode
	Y AMPLIFIER	5V
	X TIME BASE	100 mS
	METER	Xtal Current
	KLYSTRON SWEEP AMPLITUDE (or SPECTRUM EXPANSION)	Maximum anti-clockwise position.
	PRE-AMP GAIN	Maximum
	SET LEVEL	Adjusted to give about 1 mA Crystal Current on Meter.

Temporarily adjust RV19 to a mid-way position.

7.3.5. Contd.

Adjust the KLYSTRON REFLECTOR VOLTS and the KLYSTRON TUNING controls to obtain the full klystron mode on the Display.

Set	OPERATION	Analyser
	Y AMPLIFIER	Pre-Amp

The ends of the klystron mode will break through and be observed as two spikes on the trace.

Inject a source of S BAND PULSES to one of the two co-axial plugs on the waveguide. Vary the KLYSTRON TUNING control and at the same time keeping the two spikes of the klystron mode central by the slight adjustment of the KLYSTRON REFLECTOR VOLTS control until the spectrum of the S Band Pulses appears. Increase the KLYSTRON SWEEP AMPLITUDE (or SPECTRUM EXPANSION) control clockwise, adjusting, if necessary, the KLYSTRON REFLECTOR VOLTS control, so as to expand the "envelope" of the spectrum. Adjust the PRE-AMP GAIN and the output level of the S Band Pulses for the optimum display.

Observe the brightness of the spectra pulses. If the base line is bright compared to the pulses turn RV19 in a clockwise direction. Similarly, if the pulses are too bright causing defocussing, turn RV19 in an anticlockwise direction.

The optimum position of RV19 is obtained when the spectra pulses are bright and the base line is faint and if the BRILLIANCE control is turned down the base

7.3.5. Contd.

line disappears with little change in brightness of the spectra pulses.

NB. The BRILLIANCE control may be fully anti-clockwise and the spectra pulses be still visible.

Change to the 30 mS and 300 mS TIME BASE RANGES checking that the "bright up" circuit is working correctly.

Finally seal the Pre-Set Control RV19.

7.4. TEST EQUIPMENT REQUIRED FOR THE SETTING UP AND TESTING OF THE MW 69/S

7.4.1. POWER UNIT

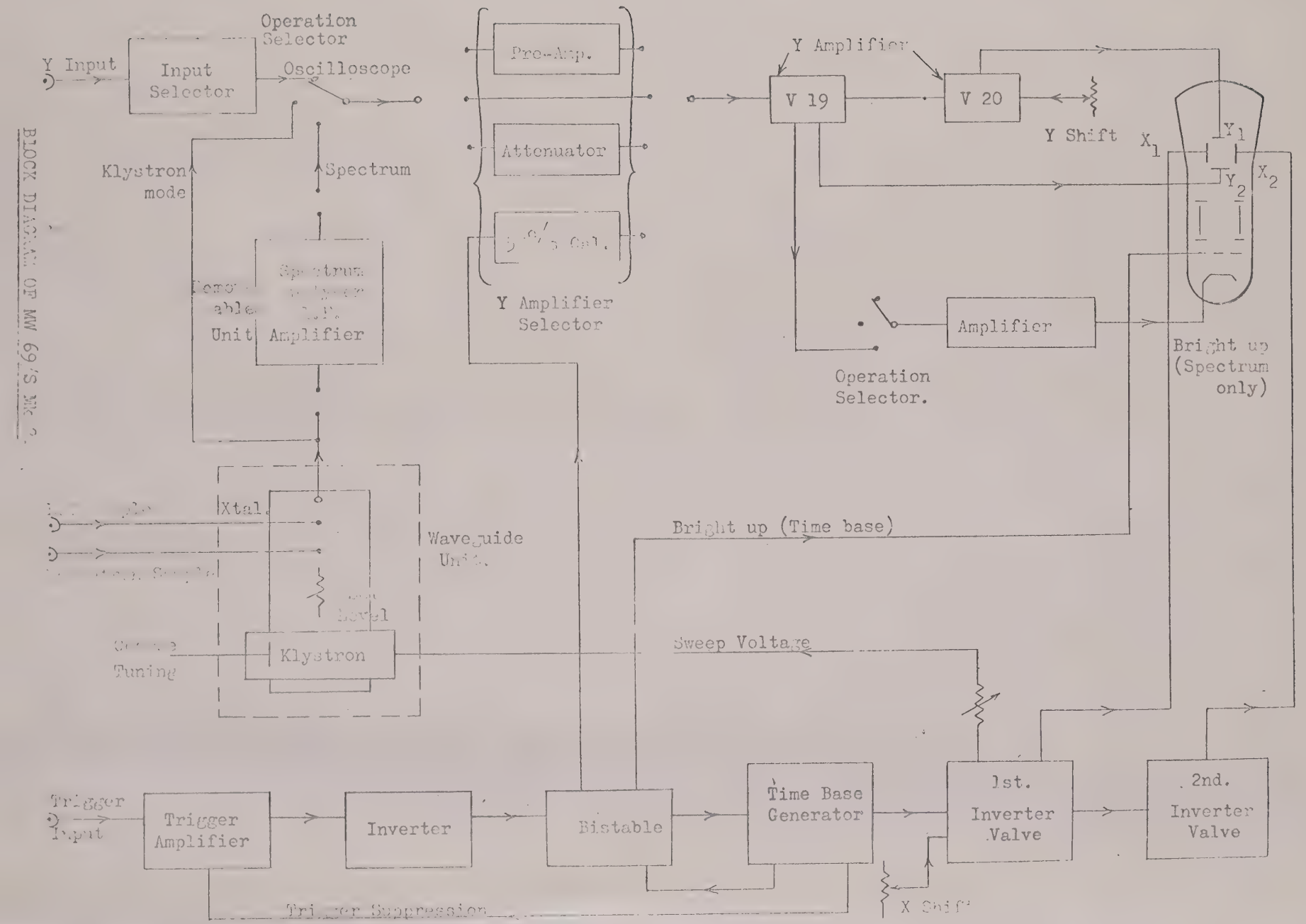
1. Sub standard Voltmeter.
2. Avometer Model 8.
3. Oscilloscope capable of giving a deflection sensitivity of at least 10 mV/cm e.g. Solartron CD513 or CD523.
4. A variable load capable of working at 250V, 0-25mA.
5. 1 off 1µF 2½KV Condenser (e.g. TCC CP150 KO)
   1 off 1M ohm ¼W 10% resistor.
   5 off 470 K ohms Erie type 8 or Morganite Type Y Resistors.
   1 off 22K ohm Welwyn AW3112 6W. 300V working resistor.
   1 off 18K ohm Welwyn AW 3112 6W. 300V working resistor.

7.4.2. DISPLAY UNIT

1. B.C. 221 wavemeter.
2. MW67 Test Set.
3. OPS 100C Solartron pulse generator.
4. Venner frequency and time measuring unit TSA 1035P.
5. 400C Dawe wide range oscillator.
6. TF 801A Marconi signal generator.
7. Marconi signal generator TF 144G or TF 995A (Series)
8. TF 885A/1 Marconi video oscillator.
9. Wayne Kerr AF Oscillator Type S 121.
10. Wayne Kerr video oscillator Type 0228
11. CD513 or C523 Solartron oscilloscope.
12. 75 ohms attenuator variable from 0 to 9 dBs.
13. Model 8 avometer.
14. Sub-standard voltmeter.
15. D.C. reference voltage supply capable of giving up to $\pm$ 500V.
16. Components: 3.9M ohms. $\frac{1}{4}$W. 10% resistor.
    330 ohms $\frac{1}{4}$W. 10% resistor.
    1K ohm $\frac{1}{4}$W. 10% resistor.
    10K ohms $\frac{1}{4}$W. 5% resistor.
    1K ohm LHNAR potentiometer.
    6.8K ohms Welwyn AW3112 resistor.
    1$\frac{1}{2}$V battery (obtainable from Avometer)
    47 pF 250V 20% capacitor.

7.4.3. MICROWAVE UNIT

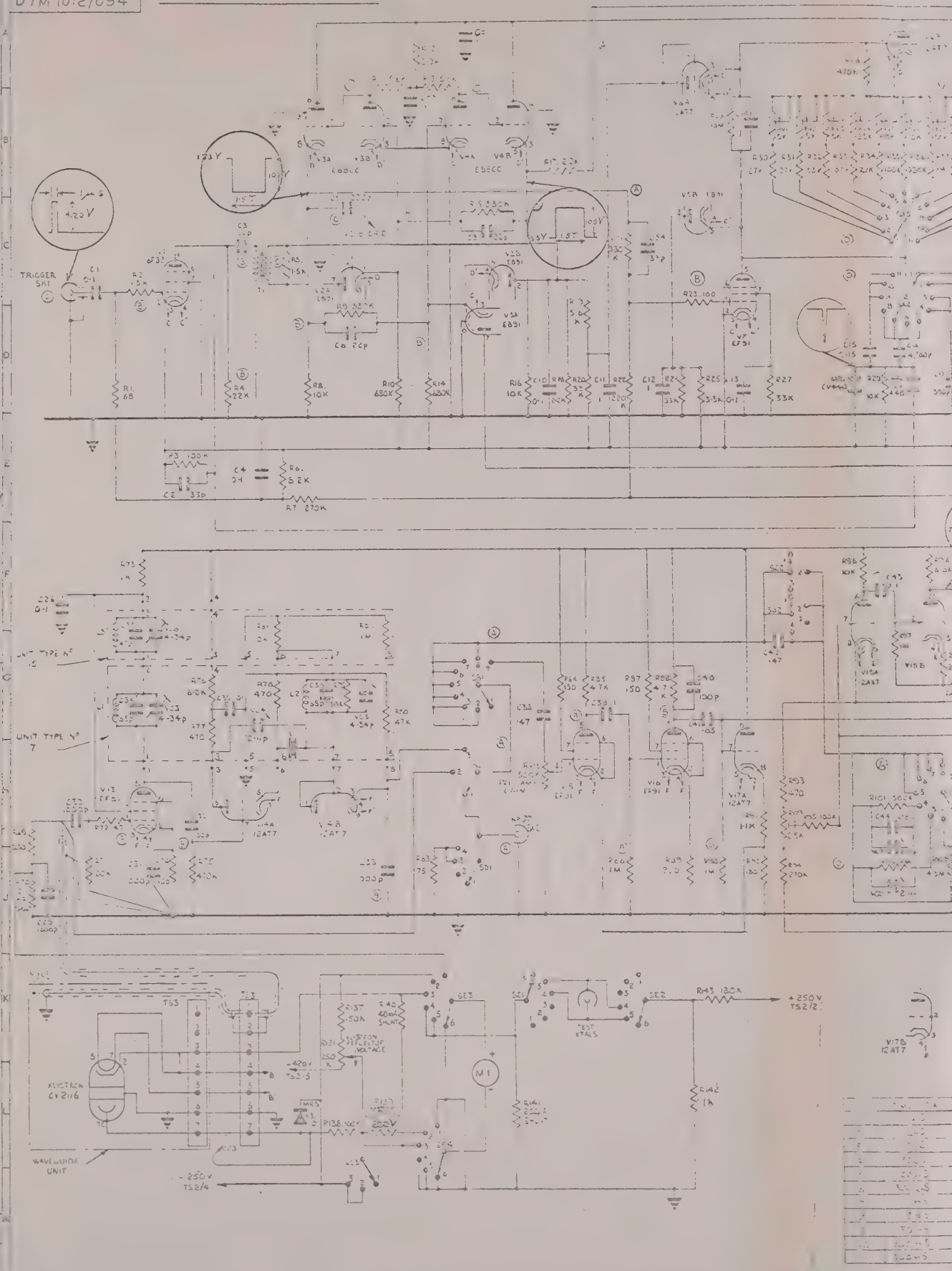
1. Avometer Model 8.
2. MW 40A/S oscillator.
3. Grade 1 standing wave detector in WG10.
4. Pulsed S Band oscillator.

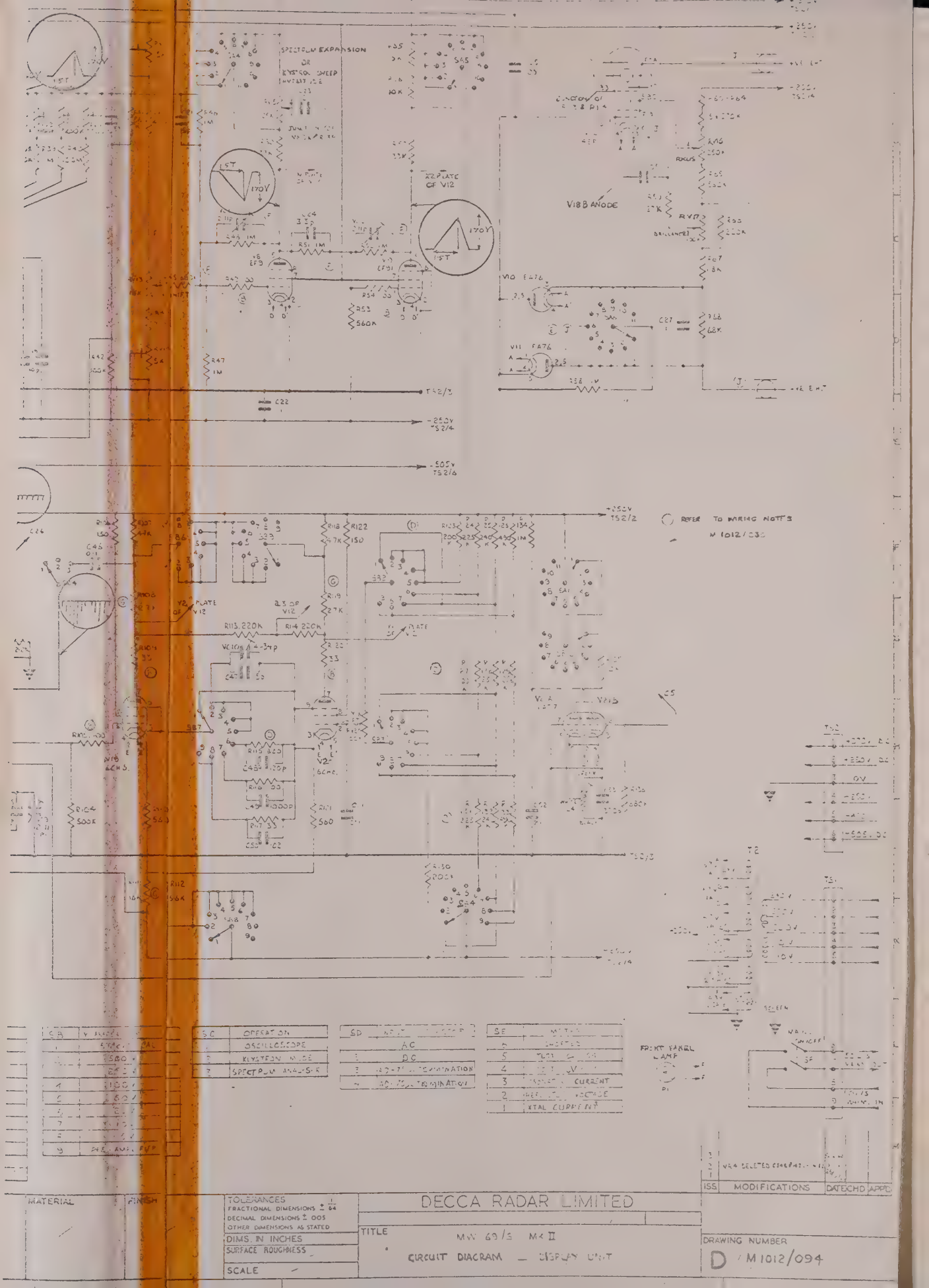

BLOCK DIAGRAM OF MW 69/S MK 2.
Operation Selector
Y Input
Input Selector
Oscilloscope
Pre-Amp.
Attenuator
Y Amplifier Selector
Y Amplifier
V 19
V 20
Y Shift
X_1
Y_1
Y_2
X_2
Klystron mode
Spectrum
Unit
Amplifier
Amplifier
Operation Selector.
Bright up (Spectrum only)
Xtal
Waveguide Unit
Bright up (Time base)
Klystron
Tuning
Sweep Voltage
Trigger Input
Trigger Amplifier
Inverter
Bistable
Time Base Generator
1st. Inverter Valve
2nd. Inverter Valve
Trigger Suppression
X Shift

DRAWING NUMBER
D/M 1012/094

THIRD ANGLE PROJECTION

USED ON

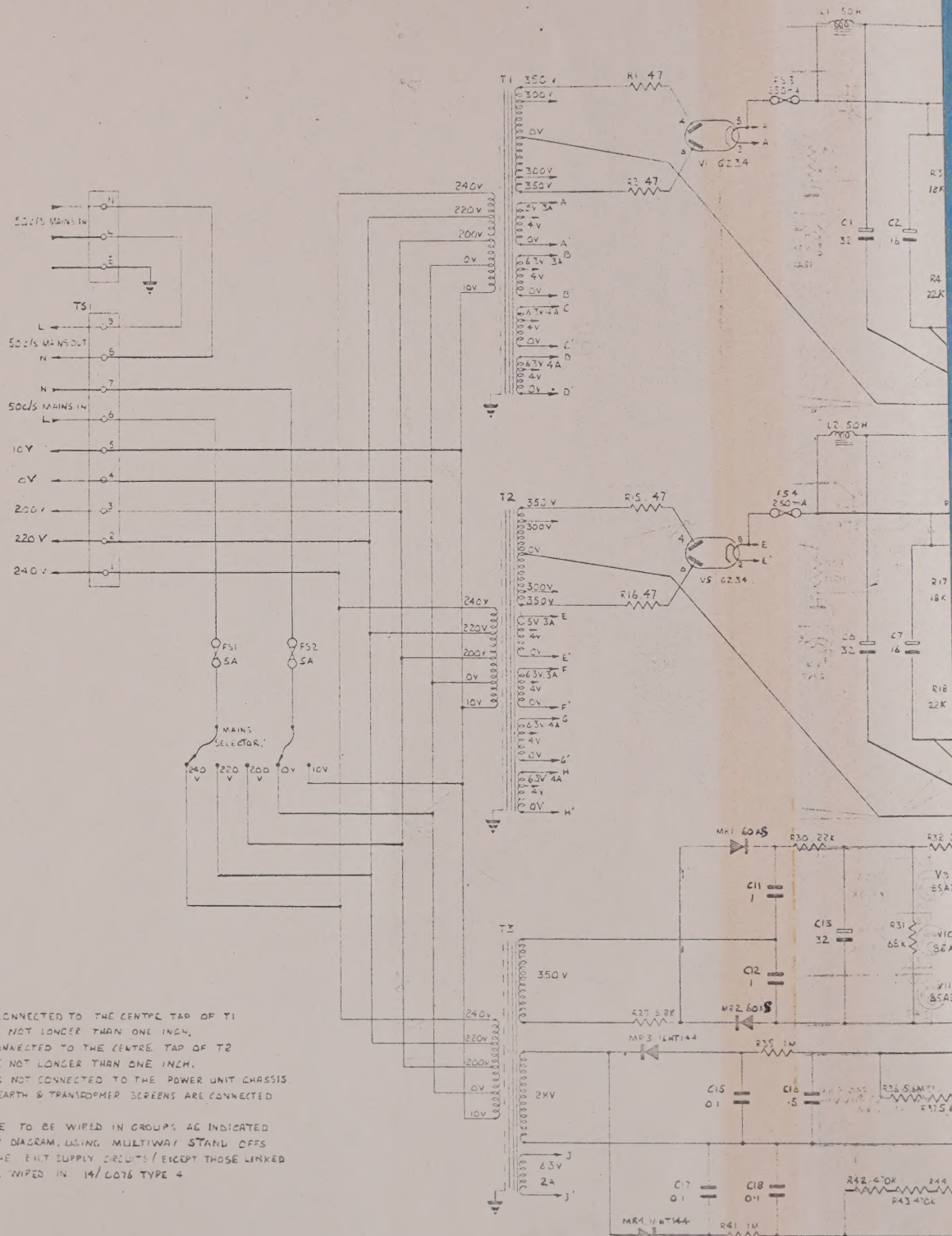



SPECTRUM EXPANSION
OR
KLYSTRON SWEEP
INHIBIT MODE
+250V TS2/4
-850V TS2/4
-505V TS2/6
TS2/3
+250V TS2/2
REFER TO WIRING NOTES M 1012/C30
V18B ANODE
X2 PLATE OF V12
Y2 PLATE OF V12
Y1 PLATE OF V12
FRONT PANEL LAMP
SCREEN
MODIFICATIONS
DATE
CHD
APPD
MATERIAL
FINISH
TOLERANCES
FRACTIONAL DIMENSIONS ± 1/64
DECIMAL DIMENSIONS ± .005
OTHER DIMENSIONS AS STATED
DIMS. IN INCHES
SURFACE ROUGHNESS
SCALE
DECCA RADAR LIMITED
TITLE
MW 69/S MK II
CIRCUIT DIAGRAM — DISPLAY UNIT
DRAWING NUMBER
D / M1012/094

DRAWING NUMBER
D/M 1018/1/S2

THIRD ANGLE PROJECTION

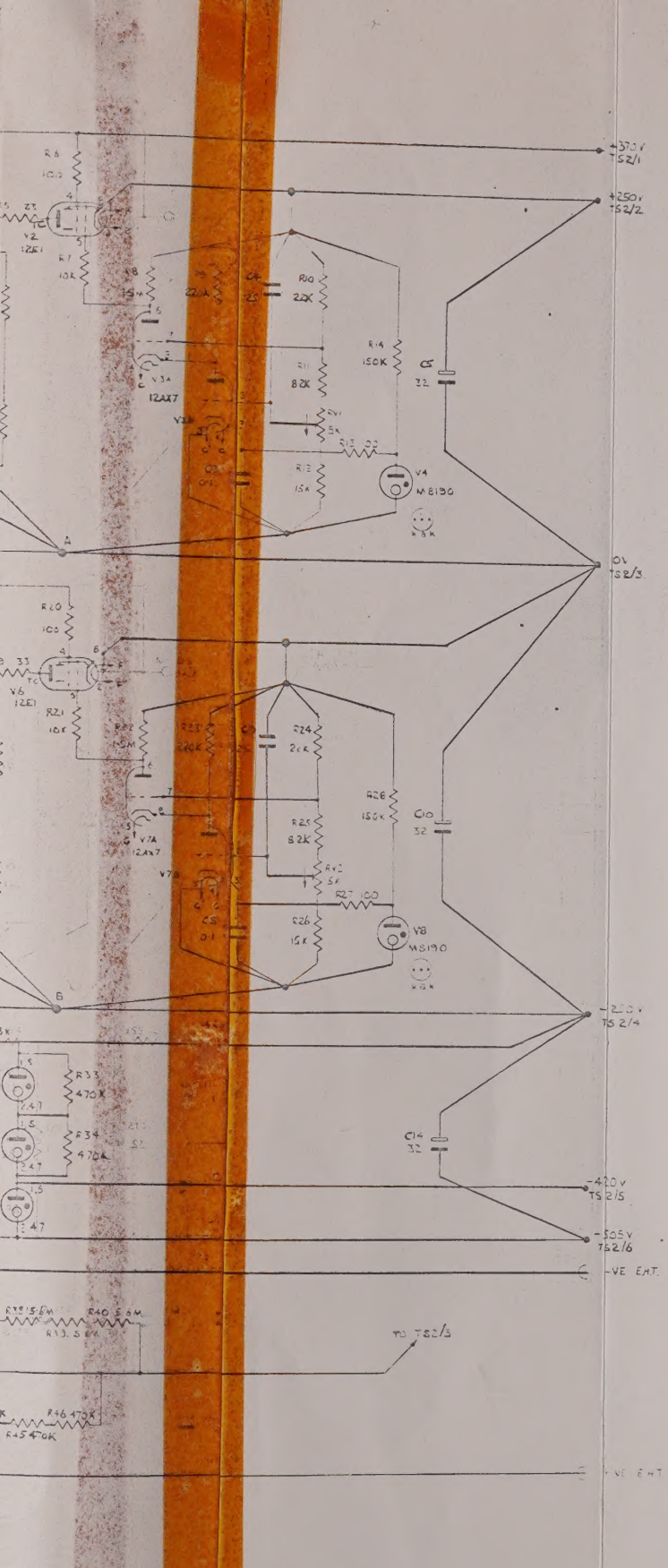
USED ON



WIRING NOTES

1. POINT A TO BE CONNECTED TO THE CENTRE TAP OF T1 BY 18 S.W.G. WIRE. NOT LONGER THAN ONE INCH.
2. POINT B TO BE CONNECTED TO THE CENTRE TAP OF T2 BY 18 S.W.G. WIRE NOT LONGER THAN ONE INCH.
3. THE 0V. LINE IS NOT CONNECTED TO THE POWER UNIT CHASSIS ONLY THE MAINS EARTH & TRANSFORMER SCREENS ARE CONNECTED TO THE CHASSIS.
4. COMPONENTS ARE TO BE WIRED IN GROUPS AS INDICATED ON THE CIRCUIT DIAGRAM, USING MULTIWAY STAND OFFS
5. ALL LEADS IN THE H.T. SUPPLY CIRCUITS (EXCEPT THOSE LINKED TO TS2/3) TO BE WIRED IN 14/0076 TYPE 4

APP PROD	
DATE	
DES APP	
DATE	
CHECKED	
DATE	
TRACED	
DATE	
DRAWN	
DATE	



ISS	MODIFICATIONS	DATE	CHD	APP'D
2				
1				

MATERIAL	
FINISH	
TOLERANCES	FRACTIONAL DIMENSIONS ± 1/64 DECIMAL DIMENSIONS ± .005 OTHER DIMENSIONS AS STATED
DIMS. IN INCHES	
SURFACE ROUGHNESS	
SCALE	—
DECCA RADAR LIMITED	
TITLE	M.W. 69/S MK II CIRCUIT. DIAGRAM - POWER UNIT
DRAWING NUMBER	D/M 1012/032

MP MASTER
MA23490